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FINAL REPORT

20000268

UTILIZATION OF A DRAPER PICKUP ON A ROUND BALER

Funded by
The Agriculture Development Fund

March 2002
Prepared by: PAMI

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ADF Project No. 20000268
PAMI Project No. 28001R
Date: January 2002

RESEARCH REPORT

Utilization

Of a

Draper Pickup

On a

Round Baler

For:

Agriculture Development Fund
Manitoba Rural Adaptation Council

ADF Project No. 20000268
PAMI Project No. 28001R
Date: January 2002

Final Report

Utilization Of a Draper Pickup

On a Round Baler

Prepared For:

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PAMI gratefully acknowledges the contributions made by the funding agencies. Without such support this research project would not have been possible.

Disclaimer

Any data, analysis of data, project results and conclusions or other information contained herein are those of the Prairie Agricultural Machinery Institute and not those of the Saskatchewan Agriculture Development Fund or those of the Manitoba Rural Adaptation Council.

1. Summary

PAMI adapted a draper style pickup on a round baler in order to determine the ease of installation, and to test the effectiveness of the pickup in reducing leaf loss while baling alfalfa.

Overall, it was found that a draper style pickup could be easily adapted and installed onto a round baler. Under some conditions, food value was increased by use of the draper pickup. But, prototype design challenges, and wide variation in crop condition made exact measurement of benefits impossible.

It is recommended that further research take place to improve the design of the draper pickup and to more accurately measure the possible benefits with regards to reducing the leaf loss. It is further recommended that other means of determining pickup loss be investigated.

2. Technical Report

2.1 Background and Objectives

Prairie Agricultural Machinery Institute (PAMI) evaluations on round and square balers between 1978 and 1992 indicated that pickup losses were in excess of 1%. The significance of this loss is that virtually all of the loss is in the form of leaves, which is a key source of protein in the forage. There have been no major advances in drum pickup (**Figure 1**) technology that would solve this loss problem. PAMI felt that a draper style pickup would be much less aggressive and may reduce this loss to practically zero.

It was felt that a draper pickup could be adapted to either a round or square format baler but there may be significant obstacles on either format or any one make of baler. PAMI chose to adapt a draper pickup to a round baler, as it is the most commonly used format in the Prairies.

The objectives of this project were to:

- Determine the ease of installing a draper style pickup onto a round baler.
- Test the effectiveness of the pickup in reducing leaf loss at two different hay moisture contents.

No literature was found outlining previous research that was conducted regarding subject matter. There was, therefore, no guidance as to what previously worked well or did not work. It was hoped that if the project was successful a manufacturer in the Prairies may begin to build and retrofit draper pickups onto existing balers, and eventually draper pickups may be offered as optional equipment on new balers.

2.2 Project Activities and Achievements

The pickup fabrication and fieldwork on this one-year project occurred from June 1st to September 30th 2001. The first task or activity of this project was to source a round baler and a draper pickup manufacturer that could supply the necessary parts for fabrication.

2.2.1 - Pickup Conversion

A New Holland 855 was chosen due in part because of previous work that PAMI had conducted with this round baler during the Evaluation Program (See PAMI Report 555). It was a good, dependable fixed chamber baler, which made hard-core bales. Leaf losses from the chamber were fairly low at normal moisture contents and the large diameter drum pickup made it a good candidate to see a noticeable difference in the pickup related leaf losses. The large diameter means that the pickup must be more aggressive in lifting the hay further and even pushing the hay swath back upon itself prior to lifting.

Several draper pickup manufacturers located in the Prairies were contacted. Wheatheart Manufacturing (See **Appendix II** for contact information) was very interested in participating and had a pickup that looked as though it would fit the New Holland 855 with minimal intervention.

The draper pickup consisted of two sets of belts, an upper and lower set (**Figure 2**), with only the lower set having pickup teeth attached to them. The upper set of belts had slats to help move the hay from the lower belts onto the bale-forming roller at the bottom of the bale chamber. This was the normal design for the draper pickup when used on a combine harvester and the manufacturer recommended that PAMI keep a similar design on the round baler.

PAMI personnel designed and carried out modifications to adapt the draper pickup (**Figures 2 and 3**) to the New Holland 855. The modifications consisted of developing pickup sidewalls that fit inside the sidewalls of the baler and still yield maximum pickup width. Side shields were developed that prevented hay from getting caught on square corners and from wrapping around the rotating shafts. Finally, mounts identical to the pickup mounts for the existing drum pickup were fabricated and added to the draper pickup.

The draper pickup was designed to be easily and quickly substituted for the drum pickup. This was done so that testing could be accomplished on both pickups in relatively the same conditions and to assess how easily farmers may undertake this conversion on their own. Changeover to the draper pickup was accomplished by removing the drum pickup from the baler and sliding the draper pickup into place. The draper pickup utilized a hydraulic motor drive.

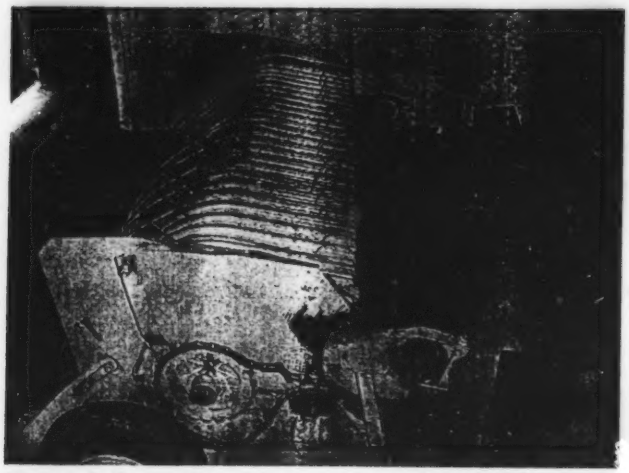

Figure 1. Drum pickup removed from New Holland 855 Round Balers.

Figure 2. Draper Pickup Adapted for use on the New Holland 855 Round Baler.

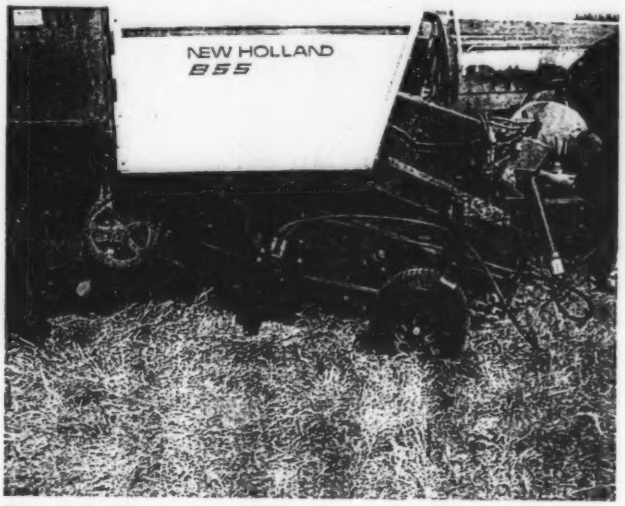

Figure 3. New Holland 855 with Draper Pickup Installed.

2.2.2 Field Testing

Field tests were conducted at the farm of Mr. Terry Carr of Oakville, MB. Mr. Carr also was owner of the New Holland 855 Round Baler used in the test.

The two pickups were operated and tested in fields of approximately 70% alfalfa / 30% bromegrass mixture. On each day one pickup was operated to make two or more bales, and then the other pickup was installed and more bales were made. This allowed the researchers to get a good set of observations and tests of each unit over varying crop and environmental conditions.

Continuous visual observation was used to determine the effectiveness of swath pickup from the field, and effectiveness and smoothness of swath feeding into the baler chamber.

Several different methods were employed or attempted to determine loss levels from each pickup. For each of these, the bottom of the baler was covered with a catch-tarp to prevent material loss from the baler itself from affecting results.

- Several close visual inspections of the field surface were made after each unit to get a qualitative feel for losses. This produced good qualitative, but not quantitative information.

- Material on the field surface was vacuumed up and weighed in an attempt to get a quantitative measure of pickup loss. This practice was

- discontinued early in the project because new loss from the pickup could not be distinguished from the considerable amount of older material lying on the field.

- Selected bales were weighed and the swath length required to make the bale was measured. This information was computed into Bale Development Rate (kg/m) to determine the relative weight per unit of swath length of material recovered by each pickup. Although this method may hold promise for future work it was not used throughout the test season. Two field variables besides pickup effectiveness may substantially affect results, namely; variation in crop yield, and variation in windrower overlap while hay cutting. Given these uncontrollable variables, and given the relatively small differences in bale weight expected from the two pickups, the number of bales made was not sufficient for statistically significant information.

- Feed value of selected bales was analyzed. This was done on the assumption that the main item of loss would be alfalfa leaves, and saving these would directly affect Crude Protein and Relative Feed Value in the baled material. These tests were continued throughout the test season. The particular dates of these tests were July 12, August 4, 23, 24 and September 5.

The field tests began during the baling of "first cut" and continued throughout the "second cut" hay harvest. The term "first cut" means the first hay to be harvested from the field in the season. Depending on weather conditions a second harvest or "second cut may be obtained.

Haying conditions of the first cut were poor. Rain hindered baling for an extended period after the hay was windrowed. Considerable second growth pushed up through the windrows, making the pickup operation as well as observations of the field surface difficult. These conditions continued throughout the July 12 and August 4 test days.

Haying conditions of the second cut were greatly improved. This not only helped pickup operation but also made observations more attainable and accurate.

2.3 Results and Discussion

Visual Observations: It appeared consistently to PAMI personnel that the draper was gentler than the drum pickup in picking and conveying the swath. There appeared to be some loss of leaves occurring toward the rear of the draper, either between the front and rear conveyors, or between the rear conveyor and the baler intake. Although this loss could not be observed directly inspection of the field surface after the baler pass seemed to indicate this.

Material restriction and plugging was also observed on the draper pickup, as shown in **Figure 4**. The length of the draper unit, and its particular design configuration resulted in a constricted intake area. This constriction made use of a wind guard difficult, and hindered its performance in bulky swath conditions.

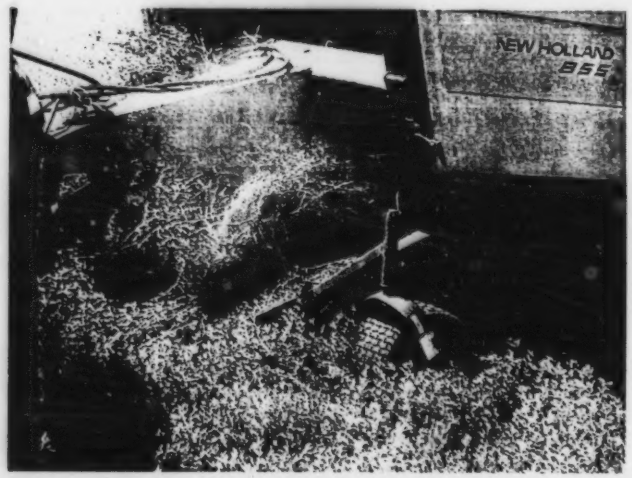

Figure 4. Plugging of Draper pickup.

These observed plugging and internal loss problems may be reduced or eliminated by removing the rear conveyor from the pickup, and shortening the front conveyor to open up the intake area and increase the performance of the wind guard. Careful redesign is required to avoid introducing new problems with these modifications.

Bale Development Rate: The Bale Development Rate data captured on July 12 and August 4 is shown in **Figure 5** below. The haying conditions under which these tests were conducted were far from ideal. Significant second growth through the hay windrows required aggressive pickup action for maximum crop recovery. Although the differences shown in the data are not of a high statistical

significance they do tend to indicate that the drum pickup was recovering more swath material from the field surface than the draper, under these conditions.

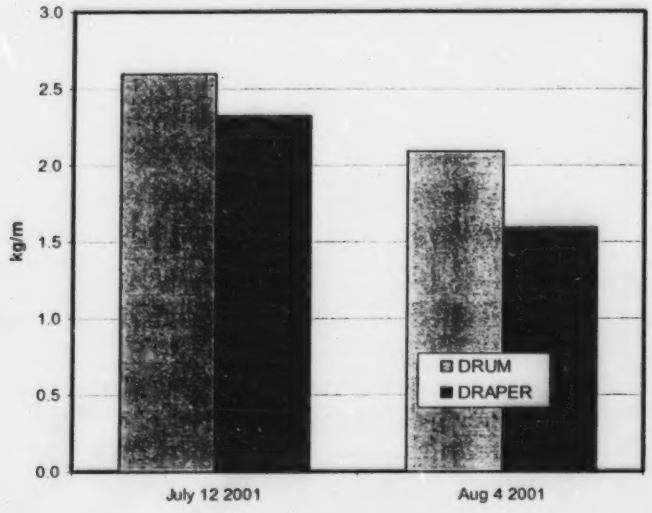

Figure 5. Bale Development Rate

Feed Value: Crude Protein and Relative Feed Values were considered the two most important criteria of feed analysis in deciding if one pickup was better than the other at maintaining the leaves on stems and harvesting better overall hay for the producer. Crude Protein is a good indicator since most of the protein contained in a plant is in the leaves. The Relative Feed Value is also a good indicator of the overall quality of the hay contained in the bale which is what the producers are concerned with in the long run.

The analysis of Crude Protein for each of test days from July 12 to September 5 is shown in **Figure 6** below. Data tables of all feed analyses are given in **Appendix I**. Although not of high statistical significance the data tends to indicate that the drum pickup captured higher crude protein than the draper during the first cut harvest. But this difference disappeared and both appeared equal during the second cut. As explained earlier, first cut conditions were well below favorable, while second cut conditions were more normally favorable. The data therefore, may indicate more about crop recovery under adverse conditions and may not show the advantage of gentle pickup action on alfalfa leaf recovery under more normal or dry conditions.

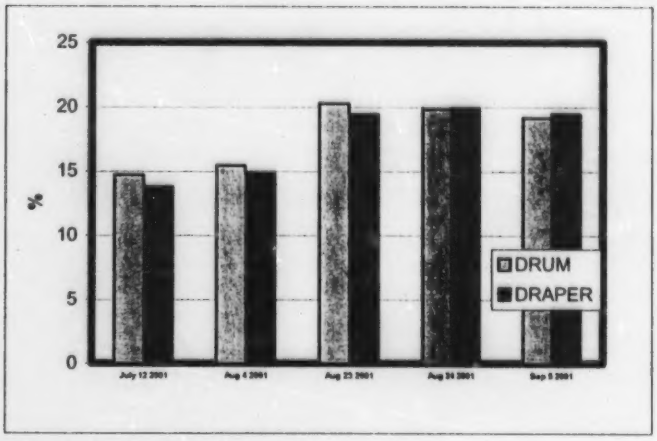

Figure 6. Crude Protein tests.

The analysis of Relative Feed Value for each of test days from July 12 to September 5 is shown in **Figure 7** below. Data tables of all feed analyses are given in **Appendix I.** Again, although not of high statistical significance the data tends to indicate that the drum pickup captured slightly higher Relative Feed Value than the draper during the first cut harvest. But this difference reversed and the draper appeared slightly better during the more favorable conditions of the second cut.

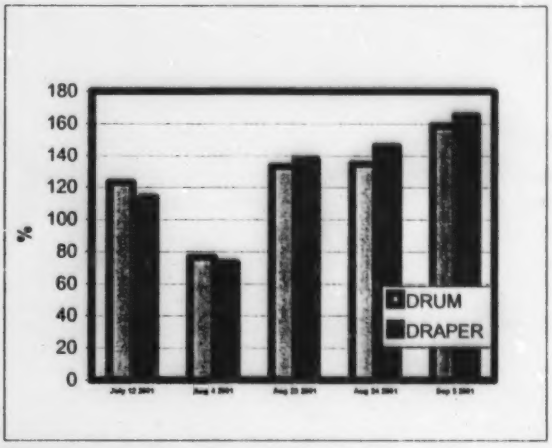

Figure 7. Relative Feed Value tests.

The data regarding Crude Protein, Relative Feed Value, and Bale Development Rate, together with the visual observations indicates that there may under some conditions be an advantage in using a draper pickup for hay recovery. However, design shortcomings of the prototype pickup and widely varying crop conditions have hindered the determination of any clear advantage.

The potential advantages of a draper pickup are significant enough that more work must be done on its development. Once the initial design is enhanced exhaustive field operation and testing should be continued to better explore this potentially beneficial technology.

2.4 Recommendations

In order to enhance this research the following specific actions should be taken:

- Redesign the draper pickup to remove the rear conveyor, and to shorten the front conveyor. Ensure an adequate intake area to the baler, and that an effective wind guard can be installed.

- Develop an accurate, effective method for measuring pickup recovery of crop material. The quantity and quality of material left by the pickup must be measured in order to accurately determine pickup performance.

- Seek to involve pickup and baler manufacturers in future work. As the technology advances these industry partners will provide valuable guidance regarding its effective implementation in current and new haying equipment.

4. Equipment

A draper pickup which would fit onto the New Holland 855 Round Baler was fabricated from components supplied by Wheatheart Manufacturing (See **Appendix II** for contact information).

The pickup was not dismantled at the conclusion of the testing. It is available should PAMI and/or the funding agencies decide further testing is warranted. If further work involving the pickup is not undertaken by March 31, 2003 the unit may be disposed of as scrap.

7. Communication of Results

Presentation, Interim Results: A Power point presentation of interim project results was prepared by project participant, Lorne Grieger and presented at a Manitoba Forage Council meeting in December 2001. Project Funders were acknowledged during this presentation. Copies of the presentation were sent to the Project Funders for their files.

Publication, Final Results: A publication will be developed, highlighting project activities and results. This publication will follow PAMI's "Research Update" model, including acknowledgement of Project Funders. Paper copies will printed and distributed to PAMI's 2000 publication subscribers during the 2002/03 fiscal year.

News Release: A news article will be prepared and released to approximately 200 news agencies in Saskatchewan and Manitoba, over the next 4 months. The article will highlight the research activities and results and the potential impact on Saskatchewan and Manitoba's agricultural industry. As is PAMI's policy Project Funders will be acknowledged in the article.

Website Posting: The publication described above will also be posted on PAMI's website.

Presentation, Final Results: A presentation of the final results of this project will be prepared in late 2001/02 or early 2002/03. An opportunity will be sought to present this information at industry gatherings in Manitoba and Saskatchewan over the next year.

Industry Update: Information packages will be delivered to appropriate manufacturers over the next year. Discussions will be held with them and Funding agencies to explore the continuation and implementation of this development work.

Appendix I

Tables 1-5 - Results of sample analysis
Tables 6-7 - Cumulative results for each of the pickups

Table 1. Results of Sample Analysis by Norwest Labs – Samples Taken July 12, 2001.

Analyte	Drum Sample #1	Drum Sample #2	Average Drum	Draper Sample #1	Draper Sample #2	Average
MC (% WB)	11.5	11.6	11.6	9.8	10.8	10.3
CP (% DB)	14.3	15.2	14.8	13.2	14.4	13.8
ADF (% DB)	36.4	34.7	35.6	37.5	36.8	37.2
NDF (% DB)	47.0	45.6	46.3	49.0	48.7	48.9
TDN (% DB)	56.98	58.39	57.69	56.04	56.67	56.36
DE (Mcal/kg DB)	2.51	2.57	2.54	2.47	2.49	2.48
RFV	120	126	123	113	115	114
DMI (% DB)	2.5	2.6	2.6	2.5	2.5	2.5
Calcium (%)	1.48	1.55	1.52	1.32	1.46	1.39
Phosphorous (%)	0.14	0.16	0.15	0.14	0.16	0.15
Potassium (%)	2.18	2.19	2.19	2.23	2.34	2.29
Magnesium (%)	0.41	0.40	0.41	0.36	0.38	0.37
Sodium (%)	0.05	0.04	0.05	0.04	0.04	0.04
Salt (%)	0.13	0.11	0.12	0.11	0.11	0.11

List of abbreviations used in all tables:

MC	Moisture Content
CP	Crude Protein
ADF	Acid Detergent Fibre
NDF	Neutral Detergent Fibre
TDN	Total Digestible Nutrients
DE	Digestible Energy
RFV	Relative Feed Value
DMI	Dry Matter Intake
WB	Wet Basis
DB	Dry Basis

Table 2. Results of Sample Analysis by Norwest Labs – Samples Taken August 4, 2001.

Analyte	Drum Sample #1	Drum Sample #2	Average Drum	Draper Sample #1	Draper Sample #2	Average
MC (% WB)	19.7	15.7	17.7	17.9	14.9	16.4
CP (% DB)	15.3	15.6	15.5	14.2	15.4	14.8
ADF (% DB)	46.9	47.5	47.2	51.1	48.0	49.6
NDF (% DB)	64.4	62.8	63.6	65.2	63.2	64.2
TDN (% DB)	47.95	47.49	47.72	44.36	47.08	45.72
DE (Mcal/kg DB)	2.11	2.09	2.10	1.95	2.07	2.01
RFV	76	77	77	70	76	73
DMI (% DB)	1.9	1.9	1.9	1.8	1.9	1.9
Calcium (%)	1.44	1.38	1.41	1.30	1.35	1.33
Phosphorous (%)	0.19	0.19	0.19	0.16	0.18	0.17
Potassium (%)	1.35	1.23	1.29	1.32	1.33	1.33
Magnesium (%)	0.44	0.41	0.43	0.41	0.43	0.42
Sodium (%)	0.08	0.06	0.07	0.08	0.08	0.08
Salt (%)	0.19	0.15	0.17	0.20	0.20	0.20

Table 3. Results of Sample Analysis by Norwest Labs – Samples Taken August 23, 2001.

Analyte	Drum Sample #1	Drum Sample #2	Average Drum	Draper Sample #1	Draper Sample #2	Average
MC (% WB)	19.2	17.8	18.5	13.1	25.3	19.2
CP (% DB)	20.6	19.9	20.3	19.9	18.9	19.4
ADF (% DB)	33.3	37.8	35.6	31.8	36.0	33.9
NDF (% DB)	40.4	45.8	43.1	40.6	44.3	42.5
TDN (% DB)	59.60	55.79	57.70	60.88	57.29	59.09
DE (Mcal/kg DB)	2.62	2.45	2.54	2.68	2.52	2.60
RFV	145	121	133	147	128	138
DMI (% DB)	3.0	2.6	2.8	3.0	2.7	2.9
Calcium (%)	1.26	1.22	1.24	1.36	1.22	1.29
Phosphorous (%)	0.20	0.24	0.22	0.18	0.20	0.19
Potassium (%)	2.82	2.79	2.81	2.58	2.71	2.65
Magnesium (%)	0.34	0.28	0.31	0.33	0.33	0.33
Sodium (%)	0.02	0.02	0.02	0.02	0.02	0.02
Salt (%)	0.05	0.06	0.06	0.06	0.06	0.06

Table 4. Results of Sample Analysis by Norwest Labs – Samples Taken August 24, 2001.

Analyte	Drum Sample #1	Drum Sample #2	Average Drum	Draper Sample #1	Draper Sample #2	Average
MC (% WB)	24.6	21.1	22.9	22.4	21.9	22.2
CP (% DB)	19.8	19.8	19.8	20.3	19.4	19.9
ADF (% DB)	35.9	33.6	34.8	32.1	32.8	32.5
NDF (% DB)	43.4	41.9	42.7	40.0	41.1	40.6
TDN (% DB)	57.44	59.37	58.41	60.63	60.08	60.36
DE (Mcal/kg DB)	2.53	2.61	2.57	2.67	2.64	2.66
RFV	130	139	135	148	143	146
DMI (% DB)	2.8	2.9	2.9	3.0	2.9	3.0
Calcium (%)	1.17	1.31	1.24	1.34	1.45	1.40
Phosphorous (%)	0.23	0.21	0.22	0.20	0.17	.19
Potassium (%)	2.52	2.67	2.60	2.60	2.50	2.55
Magnesium (%)	0.33	0.34	0.34	0.34	0.35	0.35
Sodium (%)	0.02	0.02	0.02	0.02	0.03	0.03
Salt (%)	0.05	0.05	0.05	0.06	0.07	0.07

Table 5. Results of Sample Analysis by Norwest Labs –Samples Taken September 5, 2001.

Analyte	Drum Sample #1	Drum Sample #2	Average Drum	Draper Sample #1	Draper Sample #2	Average
MC (% WB)	10.9	10.9	10.9	11.0	11.3	11.2
CP (% DB)	19.1	19.2	19.2	19.8	19.1	19.5
ADF (% DB)	28.3	27.5	27.9	26.9	28.3	27.6
NDF (% DB)	40.0	38.7	39.4	37.1	39.2	38.2
TDN (% DB)	63.88	64.56	64.22	65.11	63.94	64.53
DE (Mcal/kg DB)	2.81	2.84	2.83	2.87	2.81	2.84
RFV	155	162	159	171	159	165
DMI (% DB)	3.0	3.1	3.1	3.2	3.1	3.2
Calcium (%)	1.66	1.74	1.70	1.77	1.62	1.70
Phosphorous (%)	0.20	0.21	0.21	0.21	0.21	0.21
Potassium (%)	2.66	2.61	2.64	2.68	2.53	2.61
Magnesium (%)	0.44	0.43	0.44	0.45	0.43	0.44
Sodium (%)	0.06	0.06	0.06	0.06	0.06	0.06
Salt (%)	0.16	0.16	0.16	0.14	0.15	0.15

Table 6. Cumulative Results From All Five Days of Field Testing – Drum Pickup.

Analyte	Average July 12	Average August 4	Average August 23	Average August 24	Average September 5	Overall Average
MC (% WB)	11.6	17.7	18.5	22.9	10.9	16.3
CP (% DB)	14.8	15.5	20.3	19.8	19.2	17.9
ADF (% DB)	35.6	47.2	35.6	34.8	27.9	36.2
NDF (% DB)	46.3	63.6	43.1	42.7	39.4	47.0
TDN (% DB)	57.69	47.72	57.70	58.41	64.22	57.15
DE (Mcal/kg DB)	2.54	2.10	2.54	2.57	2.83	2.52
RFV	123	77	133	135	159	125
DMI (% DB)	2.6	1.9	2.8	2.9	3.1	2.7
Calcium (%)	1.52	1.41	1.24	1.24	1.70	1.42
Phosphorous (%)	0.15	0.19	0.22	0.22	0.21	0.20
Potassium (%)	2.19	1.29	2.81	2.60	2.64	2.31
Magnesium (%)	0.41	0.43	0.31	0.34	0.44	0.39
Sodium (%)	0.05	0.07	0.02	0.02	0.06	0.04
Salt (%)	0.12	0.17	0.06	0.05	0.16	0.11

Table 7. Cumulative Results From All Five Days of Field Testing – Draper Pickup.

Analyte	Average July 12	Average August 4	Average August 23	Average August 24	Average September 5	Overall Average
MC (% WB)	10.3	16.4	19.2	22.2	11.2	15.9
CP (% DB)	13.8	14.8	19.4	19.9	19.5	17.5
ADF (% DB)	37.2	49.6	33.9	32.5	27.6	36.2
NDF (% DB)	48.9	64.2	42.5	40.6	38.2	46.9
TDN (% DB)	56.36	45.72	59.09	60.36	64.53	57.21
DE (Mcal/kg DB)	2.48	2.01	2.60	2.66	2.84	2.52
RFV	114	73	138	146	165	127
DMI (% DB)	2.5	1.9	2.9	3.0	3.2	2.7
Calcium (%)	1.39	1.33	1.29	1.40	1.70	1.42
Phosphorous (%)	0.15	0.17	0.19	0.19	0.21	0.18
Potassium (%)	2.29	1.33	2.65	2.55	2.61	2.29
Magnesium (%)	0.37	0.42	0.33	0.35	0.44	0.38
Sodium (%)	0.04	0.08	0.02	0.03	0.06	0.05
Salt (%)	0.11	0.20	0.06	0.07	0.15	0.12

Appendix II

Contact Information

Draper Pickups
Ken Purdy
Wheatheart Manufacturing
3455 Idywyld Drive N.
Saskatoon, SK
S7K 5Z7

Phone: (306)934-0611
Fax: (306)934-6020
www.wheatheart.com

Manufacturers Draper Pickups but was not a participate in this project,

Loren Katzenberger
Precision Metal Fabricating Ltd.
240-103 Street East
Saskatoon, SK
S7N 1Y7

Phone: (306) 955-3700
Fax: (306) 955-7222
www.pima.ca/members/premetfab.htm

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For further information with regards to this report contact:

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